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ABSTRACT

A high pulse repetition frequency (PRF) plasma gun is provided, which gun inlets a selected propellant gas into a column formed between a center electrode and a coaxial outer electrode, utilizes a solid state high repetition rate pulse driver to provide a voltage across the electrodes and provides a plasma initiator at the base of the column, which is normally operative when the driver is fully charged. For preferred embodiments, the initiator includes a solid state simulated RF driver, the outputs from which are applied to electrodes affixed in an insulator and producing a high voltage field at a surface of the insulator which forms part of the base end of the column. The plasma expands from the base end of the column and off the exit end thereof.

When used as a thruster, for example in space applications, the driver voltage and electrode lengths are selected such that the plasma for each pulse exits the column at approximately the same time the voltage across the electrodes reaches zero, thereby maximizing the thrust. When used as a radiation source, the voltage and electrode length are selected such that the plasma exits the column when the current is maximum. The plasma is magnetically pinched as it exits the column, thereby raising the plasma temperature, energizing an element in fluid state applied to the pinch, for example through the center electrode, to provide radiation at a desired wavelength. The element may also be applied to the pinch by forming at least one of the center and outer electrodes of a sintered powder refractory metal, the element in fluid form being wicked into the electrode. The plasma gun parameters can be selected to achieve a desired wavelength, which may for example be within the EUV or VUV band. The pulse driver preferably provides a high voltage spike followed by a lower voltage, longer duration sustainer signal, most of the driver energy being provided by the sustainer signal. The plasma gun of this invention, which is capable of operating at PRFs in the range of approximately 100 Hz to in excess of 5,000 Hz, may also be used in other applications.